IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

DECLARATION UNDER 37 CFR 1.132	Atty. Docket No. **SYMM1110-1**

Applicant **Kishan Shenoi**	
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Title **CDMA Pilot Tracking for Synchronization**	
Group Art Unit **2631**	Examiner **Bayard, Emmanuel**
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John J. Bruckner

Commissioner for Patents
P.O. Box 1450
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Dear Sir:

I, Kishan Shenoi, declare as follows:

I am the inventor of the above-identified pending U.S. utility patent application.

All of independent claims 1, 14, 23, 24 and 34 are now amended to require that the present invention's correlation values that are averaged over multiple periods of the PN signals (e.g., long code) are between the signal and the long code itself. This important limitation is explicitly recited in independent claims 1, 14 and 23 as "over multiple periods of the PN signals." This important limitation is similarly explicitly recited in independent claims 24 and 34 as "over multiple periods of the chip-rate PN sequence." **Higuchi simply does not disclose or suggest averaging correlations between a signal and the long code itself.** This will be explained in more detail in the following paragraphs.

IS-95 CDMA, as practiced in North America and elsewhere is indeed a form of DS-

CDMA where multiple spreading codes are employed (see Higuchi col. 1, lines 26-35). In particular, a 64-length Gold code is the "short code" with period equal to that of an information symbol (bit). This "short code" can be used to separate channels of information (each user would use one channel). PN codes length $2^{15} = 32768$ are superimposed (there are two, specifically, a first for the I channel and a second for the Q channel) and these, together are referred to as the "long code" by Higuchi, can be used to distinguish base stations. In IS-95 CDMA, all base stations use the same long code but each base station uses a different time offset (thus base stations are distinguished by their time offset).

Higuchi (and Naden) are concerned with a DS-CDMA receiver, and thus are primarily concerned with data (information) extraction. Synchronization for both Higuchi and Naden, in terms of establishing the start of the spreading code is vital for data extraction and must be done in the case of Higuchi and Naden both rapidly and with enough accuracy to reliably extract the data (information). In contradistinction to both Higuchi and Naden, the claimed invention is directed to a measurement methodology that is concerned with making a very precise and accurate estimate of the start of the spreading code that is completely independent of a need to extract data; the claimed invention (this estimation) can be done over intervals of time much longer than the symbol interval.

Higuchi is concerned with acquisition and more importantly the need to acquire code synchronization in a rapid manner (see Higuchi col. 3, lines 33-65). To this end, Higuchi proposes masking the second code group for M (≥1) symbols at fixed intervals (see col. 4 lines 12-17 and Claim 1). As is clear from Higuchi Fig. 15 and Fig. 7, the correlation is performed between the input signal *and the short code*. Clearly this correlation can be done only in the window of M symbols while the long code is masked. Higuchi recites the need for introducing this window where the long code is masked at the same point in each long code period and thus the statement in Higuchi at col. 14, lines 3-5 "… as shown in Fig. 15 (correlation values are also available which are obtained by averaging over a plurality of long code periods),…" necessarily implies that the averaging of Higuchi, if done at all, is done of the correlation values obtained over M symbols (the masking interval) in consecutive long code periods. Considering that this is being done by Higuchi in the acquisition phase and so the local time-base has not yet been

synchronized to the transmitter time-base, it is unlikely that averaging over many periods will beneficial; in fact averaging over many long code intervals is contraindicated by Higuchi.

Thus, it is thus very clear that while Higuchi teaches that averaging during a plurality of long code time periods may be employed, every one of Higuchi's averaged correlations is **between the short code and the input signal because they are constructed during intervals when the long code is masked and unavailable to Higuchi**. Therefore, Higuchi teaches away from the presently claimed invention that includes averaging a correlation between a signal and the long code itself.

In IS-95 CDMA, an arena to which embodiments of the invention may be directed, there is no masking interval for the "long code" (i.e., both the I PN sequence and the Q PN sequence are continuous with no gaps). This Application teaches embodiments including the generation of correlations using a pilot channel. The Gold code for the pilot channel is typically the null code (all 1s) which has no useful correlation properties with the input signal, especially considering that the long code is not masked in IS-95 CDMA. Therefore averaging over a plurality of long code periods of the correlation between the short code and the input signal as might be suggested by Higuchi has no bearing on the IS-95 CDMA embodiments of this invention.

What Higuchi does not describe or teach is the notion of averaging, over a plurality of long code periods, the correlation between the *long code* and the input signal. In fact, when correlation between the long code and the input signal is calculated by Higuchi, it is evident from Fig. 16 (and Fig. 17, and Fig. 18) that Higuchi reverts back to the conventional tracking receiver such as taught by Naden.

Naden teaches a methodology for DSSS (Direct Sequence Spread Spectrum) terminals. Naden teaches a DSSS receiver that is of the tracking variety. That is, a continuous monitoring and estimation of correlation must be made by Naden *on the channel being used for communication*. The Naden correlation must be made for "early", "late", and "on-time". Naden actually uses four "early" and four "late" estimates corresponding to time-offsets of (1/4), (1/2), (3/4), and (1) chips. Furthermore, the tracking aspect of the Naden receiver mandates that these four estimates be done for *each period* of the spreading code and Naden must dwell on his single spreading code 100% of the time. The Naden reference does not disclose or suggest averaging

over multiple code periods.

In general, Naden's teachings relate to a *DSSS radio with the emphasis on communications* and the attendant need for low power, long battery life, power management, and such attributes. In sharp contrast, the claimed invention is closer to the notion of a *measurement instrument* that monitors radio transmission and extracts the information necessary to discipline a high quality oscillator such as a Rubidium Atomic Standard or high performance oven controlled crystal oscillator ("OCXO").

With regard to claims 44-47, these embodiments of the claimed invention require averaging C_{MS} over multiple correlation computations in order to reduce the impact of any extraneous signal." This embodiment of the invention can provide the significant advantage of reducing the impact of an extraneous signal.

With regard to claims 48-49 and 51-52, these embodiments of the claimed invention require synthesizing an offset to improve precision of an estimate of time-of-arrival of a received pilot code based on a ratio of i) a sum of correlation values prior to on-time to ii) a sum of correlation values after on-time. These embodiments of the invention can correlate lags smaller than the sampling interval by interpolation. These embodiments of the invention can provide a finer grain of lags than the $4f_c$ (where f_c is the chip rate) sampling interval of Naden. Referring to the first full paragraph of page 27 of this application as originally filed, a specific algorithm for implementing this embodiment of the invention is described.

With regard to claims 20, 43 and 53-58, these embodiments of the claimed invention require tracking multiple pilots. Referring to the first sentence of the last full paragraph of page 20 of this application as originally filed, it is stated that "[b]y using multiple correlators in parallel, or by 'time-sharing' correlators, multiple pilots can be tracked. This embodiment of the invention provides significant advantages when multiple pilots are available. Naden's architecture can work only with a single channel, corresponding to a channel being used for communication. Therefore, Naden teaches away from these embodiments of the claimed invention. The 'time-sharing' embodiments of claims 55-58 do not "dwell" on a pilot channel 100% of the time but can observe it for a while and then come back to it later by remembering the (approximate) location of time-of-arrival relative to the local counter. This is facilitated by

the doing several correlation lags just in case the "on-time" location has moved, which it could if the local time-base is offset somewhat from the transmitter time-base.

With regard to claims 59-62, these embodiments of the claimed invention require the use of *different PN codes for the I and Q channels*, requiring the receiver to do likewise. In sharp contrast, Naden teaches a receiver that can only be used with a single PN code. Naden teaches a conventional DSSS radio architecture whereby the phase difference between the local oscillator and the remote transmitter is rendered moot by applying the dispreading code to both I and Q channels. This is emphasized by Fig. 11 of Naden which shows a single PN code generator (1120) that is applied to both the I and Q channels.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

OCT. 14, 2004
Dated:

Kishan Shenoi
Name: Kishan Shenoi